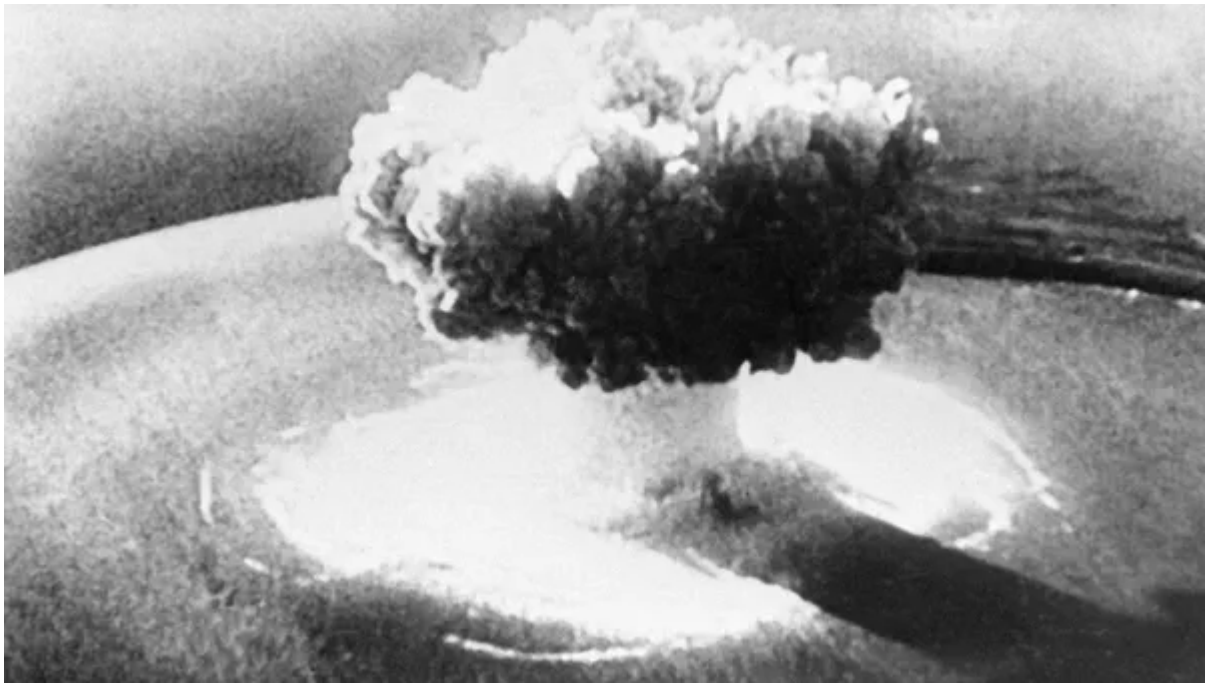
03:18 02/23/2018 (updated: 09:25 03/03/2020)

Project "49": how young geniuses created the basis of Russia's thermonuclear arsenal



MOSCOW, February 23 – RIA Novosti. Exactly sixty years ago, a nuclear test took place at the test site on Novaya Zemlya, which is rarely written about, in contrast to the tests of the first domestic atomic charge in August 1949, as well as the superbomb (aka ‘‘Tsar Bomba’’ and ‘‘Kuzkina Mother’’) in October 1961. But the date February 23, 1958 was of exceptional importance for the future of the country: it was then that a charge with the symbol ‘‘49’’ was tested, which became the basis of the thermonuclear arsenal of the Soviet Union and present-day Russia.

It is noteworthy that that breakthrough was made by very young and, moreover, extremely talented people who relatively recently received university diplomas and broke through difficulties with their ideas, including the skepticism of senior colleagues who stood at the origins of the Soviet atomic project.

The path to a thermonuclear breakthrough

How and why exactly did the charge (or, as the developers themselves say, the product) ‘‘49’’ become the starting point for the history of modern domestic thermonuclear weapons?

The Soviet Union, having conducted the first atomic test in August 1949 and deprived the United States of its monopoly in this area, in the early 1950s already began to lag behind America in mastering the technologies for creating new, much more powerful thermonuclear charges.

Thermonuclear weapons are based on the use of a gigantic amount of energy released during the fusion of nuclei of hydrogen isotopes - deuterium and tritium (hence the hydrogen bomb). But this is possible only at temperatures of tens and hundreds of millions of degrees (hence another common name for this type of weapon - thermonuclear) and pressure of hundreds of millions of atmospheres. Therefore, the thermonuclear reaction in a hydrogen bomb is ignited by an atomic charge, which uses the energy of fission of atomic nuclei.

A full-fledged thermonuclear charge is considered to be one whose energy release (main characteristic) is largely determined by the energy of thermonuclear fusion rather than nuclear fission.

The United States tested the first true thermonuclear weapon on November 1, 1952, at Eniwetak Atoll in the Pacific Ocean. The power of the explosion exceeded ten megatons - this was an unprecedented record for that time.

It should be noted that the device exploded at that time was an installation the size of a two-story house. But the main feature of the new approach of American physicists was the use of two stages: after the explosion of the atomic charge of the first stage, thermonuclear fuel was ignited in the

second. Ignition occurred thanks to radiation implosion - a very effective way of compressing thermonuclear fuel due to x-rays emitted during the explosion of the primary atomic charge. In this way, it is possible to create thermonuclear charges of very high (and practically unlimited) power. Soviet scientists did not know this then.

The decision came to domestic nuclear scientists in the spring of 1954. Employees of the main Soviet headquarters for the creation of atomic and thermonuclear weapons, Design Bureau - 11 (now the Russian Federal Nuclear Center - All-Russian Research Institute of Experimental Physics in Sarov), understood how best to use the principle of radiation implosion. A breakthrough approach was proposed by Yuri Alekseevich Trutnev, a representative of the younger generation of physicists who came to Sarov. He was then 26 years old - he was born in November 1927, and in 1951 he graduated from the physics department of Leningrad State University.

It became clear: the USSR received the key to solving the problem of creating powerful hydrogen charges. Based on the new principle, they developed the first real thermonuclear charge RDS-37, manufactured immediately for use in an aircraft bomb. It was successfully tested on November 22, 1955 at the Semipalatinsk test site. The final power of the explosion was 1.6 megatons. The Soviet breakthrough to the technologies of creating full-fledged thermonuclear weapons took place. But it was still a long way from equipping carriers, especially missiles, with such charges.

As Trutnev recalled, even before testing the RDS-37, he already had an idea for a more advanced product based on a new principle for constructing a thermonuclear charge. “After testing the RDS-37, the next day in the evening I called my friend and colleague Yuri Nikolaevich Babaev to the shore of the Irtysh and said: “Yura, let’s try to make something like this.” And he agreed,” Trutnev said in an interview with RIA Novosti.

‘‘The peculiarity of the new charge was that, using the basic principles of the RDS-37, it was possible to significantly reduce the overall parameters due to a new bold solution,’’ he wrote earlier, in the 2000s.

Babaev was a year younger than Trutnev and came to KB-11 after graduating from Moscow State University. Together they formed an extremely effective tandem of theorists.

Lack of faith in a new idea

When the scientists returned to Sarov, they told their leaders and senior comrades about the new idea - the chief designer of KB-11, Yuli Khariton, as well as Andrei Sakharov, Yakov Zeldovich, Evgeniy Zababakhin and others. But, to the surprise of Trutnev and Babaev, their proposal did not receive support, moreover, it was considered simply crazy. ‘‘They didn’t support us because they didn’t understand,’’ explained Trutnev.

Then a rather strange situation developed. As Trutnev noted, after testing the RDS-37, intensive work began on the development of a new principle for creating enhanced thermonuclear charges. ‘‘A powerful intellectual impulse arose, which at times acquired the character of feverish activity,’’ the scientist wrote in his memoirs. Apparently, this played a role in such an attitude towards the Trutnev-Babaev idea on the part of already honored developers: they say, you never know what young people offer, we ourselves will develop the RDS-37.

But the RDS-37 charge was not suitable for putting into service as part of Sergei Korolev’s R-7 intercontinental missile. It had to be modified to fit the ‘‘seven’’, increasing the energy release by approximately half, as required by the customer - the Ministry of Defense. Although the ‘‘49’’ product was best suited for installation on a rocket - it was smaller in size and weight than the RDS-37, and in terms of energy release it was more than twice as powerful.

But at least Trutnev and Babaev were not prevented from working. They established contacts with the Department of Applied Mathematics (APM) of the Mathematical Institute of the USSR Academy of Sciences in Moscow,

which was headed by the famous Mstislav Keldysh. The fact is that the mathematical base of KB-11 was not powerful enough at that time to calculate thermonuclear charges. The OPM developed mathematical programs that describe the processes that should have occurred during the explosion of the 49th. The developers themselves understood that the new charge would be effective and efficient, and had no doubt about its success. All that remained was to wait for the charge to be included in the field testing program.

Time for testing

But the expert commission, having allowed several other charges to be tested, indicated with regard to the ‘‘49th’’ product that its development is at the initial stage and requires additional justification. It is noteworthy that for the charges that received the go-ahead, no such justification was provided. Thus, the Trutnev-Babaev product was not included in the test plan for 1957.

An explanation may perhaps be that not all tests of the new Soviet thermonuclear charges were successful - some of them did not work at all. Suffice it to say that out of almost 30 tests from 1956-1958, 12 showed unsatisfactory results. This proved that at that time scientists did not fully understand the very complex processes that occur during the explosions of such charges, and therefore additional work was required.

By the fall of 1957, Trutnev and Babaev released a report on the calculation justification for the ‘‘49’’ charge, and a new, independent expert commission advocated testing it. ‘‘The successful testing of the ‘‘49’’ product will undoubtedly open up new opportunities for further improvement of designs,’’ the commission’s conclusions stated.

Trutnev and Babaev received support from Igor Kurchatov and the head of the Soviet nuclear industry, Minister of Medium Engineering Efim Slavsky. Thanks to them, a new charge was included in the test plan and at the end of 1957 it was delivered to the Semipalatinsk test site. But due to circumstances, the test was postponed until the next year, 1958.

Twenty-third February 1958

But in January 1958, the KB-11 scientific and technical council on charges intended for testing already emphasized that the ‘‘49th’’ product should be tested as soon as possible, because it belonged to one of the two charges considered the main ones from the point of view view of the installation on the R-12 launch vehicle. The second was the ‘‘44’’ charge, created according to a different design under the leadership of Yakov Zeldovich, but with the same weight and size characteristics as the ‘‘49th’’. The test results were supposed to show which charge, based on which physical design, would be more effective.

The urgency in carrying out the tests was explained by the fact that at the end of March a unilateral moratorium on nuclear tests declared by the Soviet Union began.

Why was February 23 chosen for testing the ‘‘49’’ charge? It was a coincidence. After all, every nuclear test is not a ceremonial fireworks display on one occasion or another, but a very complex experiment of national importance, which is preceded by careful preparation, and therefore the choice of date depends on many factors, including weather. Then the ‘‘stars aligned’’ on the 23rd.

Whose charge is better?

The result of the test, which took place on February 23 on Novaya Zemlya, was, however, quite unexpected: the power of the explosion was one and a half times higher than the calculated value and amounted to approximately 860 kilotons.

It was necessary to hastily carry out a second test, but with different, standard parameters of the primary nuclear unit. It took place on March 21st. The power of the explosion was about 650 kilotons - this was already in accordance with the calculations.

But the Zeldovich charge, tested on February 27, showed an energy release significantly less than expected. And there are no questions left about whose charge to put into production.

The principle underlying the "49" project, which has fully justified itself, began to be actively used for the development of thermonuclear charges of various categories. Here Trutnev and Babaev did not encounter resistance. And in KB-11, the work on thermonuclear charges was replanned.

"Filling" for different media

The design of the ‘‘49’’ product was attractive because it made it possible to create charges with different energy releases that could be placed on a variety of carriers. Already in July 1958, the scientific and technical council under the leadership of Kurchatov discussed options for using the ‘‘49’’ charge on launch vehicles with different ranges.

Continued US nuclear testing forced the Soviet Union to conduct a special series of tests, which began on September 30, 1958 and took place before the start of a joint moratorium with the United States and Great Britain that lasted until 1961. Then several more successful tests of thermonuclear charges, created on the basis of the design of the ‘‘49’’ product, took place. Their power ranged from 0.2 to 2.8 megatons. The charge tested on October 22 and intended for the R-7A intercontinental ballistic missile had the highest energy release.

Separately, it should be noted that in 1958, under the leadership of Yuri Trutnev, based on the ‘‘49th’’ scheme, the smallest thermonuclear charge at that time was created. Trutnev, in essence, initiated work on the miniaturization of thermonuclear weapons. He understood the great prospects of this direction and energetically defended it, but at first he did not find support from the leadership of the nuclear industry.

I had to go to Moscow to see Kurchatov. He took the developers to the scientific and technical council of the Ministry of Medium Machine Building. The leadership of the ministry spoke out against small charges there too. As Trutnev recalled, Kurchatov patiently listened to the arguments for and against, stood up, loudly hit the table with the stick with which he was walking by that time, and resolutely said: “We are testing!” This mini-charge was successfully tested on October 25, 1958.

Without interruption, the "49" product in various modifications entered service with the army and navy. On March 4, 1959 - as part of the 8K63 missile system with the R-12 ballistic missile. It is worth noting that it was on the basis of this missile that the Strategic Missile Forces were created on December 17, 1959.

In the same year, the “49” charge was equipped with the sea-based complex of the P-5 cruise missile, which was used to arm nuclear and diesel submarines. In 1961, the product was included in land-based cruise missiles, and in 1963 - in sea-based R-21 ballistic missiles, and on the first such domestic missile system, D-4, with an underwater launch.

In September 1961, as part of Operation Rose, the USSR launched the first R-12 missiles with standard thermonuclear warheads. Missiles launched from the continental part of the USSR successfully hit targets on Novaya Zemlya. And during the Cuban Missile Crisis in 1962, these missiles stationed in Cuba posed a threat to the United States.

In April 1959, the developers of the "49" project were awarded the Lenin Prize, which was presented to the laureates by Igor Kurchatov.

The basis of the strategic triad

The significance of the "49" project is difficult to overestimate. Its basic physical scheme, which makes it possible to create more economical, lightweight and small-sized hydrogen charges, formed the basis of almost all charges that form the basis of the domestic nuclear triad.

Of course, the development of the “49th” and subsequent charges became a triumph of scientific youth, not only Yuri Trutnev and Yuri Babaev, but also those who worked with them in Sarov, and young employees of another nuclear center in Snezhinsk, for example Boris Litvinov and Evgenia Avrorina.

It was also a triumph of the post-war education system, which in a dilapidated country provided the training of the most talented minds who were purposefully selected to solve the atomic problem - at that time the number one task for the state. Here it is appropriate to recall the Moscow Institute of Physics and Technology, the Moscow Mechanical Institute (now the National Research Nuclear University "MEPhI"), the "ninth" faculty of the Moscow Energy Institute.

As for the “49” charge diagram, it is not disclosed and belongs to the category of information constituting a state secret. And as long as Russia has nuclear weapons, data on Project 49 will not be declassified. But to this day, the ideas born of truly brilliant young minds in the 1950s make it possible to reliably ensure the country’s defense capability.

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